MODE INDICATOR FOR TRANSCEIVER MODULE

Background of the Invention

This invention relates to a pluggable transceiver module for use in a fiber optic switch.

Fiber optics are increasingly used for transmitting data signals. Typically, when data is transmitted by an optical network, it must be converted from an electrical signal to a light signal, and visa versa. In order to effectuate the conversion between electrical and optical signals, a transceiver module is used at both ends of a fiber optic cable. Each transceiver module typically contains a laser transmitter circuit capable of converting electrical signals to optical signals, and an optical receiver capable of converting received optical signals back into electrical signals.

Typically, a transceiver module is electrically interfaced with a host device, such as a host computer, switching hub, network router, switch box, computer I/O or the like. In many applications is it desirable for the transceiver modules to be "hot-pluggable," that is, the transceiver module may be inserted into and removed from the host system without removing electrical power. In this way, if a transceiver module fails, it can more readily be removed from the host device and replaced with a new module without soldering or the like.

Consequently, several pluggable transceiver module designs and standards have been introduced in which a pluggable transceiver module plugs into a receptacle which is electronically connected to a host circuit board. For example, such a standard is delineated in the Small Form-Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), dated September 14, 2000. Such standards define a receptacle or cage that receives a transceiver module. The cage includes a cage latch. The transceiver module includes a latch boss which fits into the cage latch. The transceiver module also includes an actuator configured to engage the cage latch and deflect the cage latch away from the latch boss, thereby releasing the transceiver module from the cage. An exposed

feature of the transceiver module is color coded to indicate if the transceiver module is multi-mode or single mode.

Typically, fiber optic components use color to designate mode (e.g., wavelength, contact type, product type, etc.), or in specific applications to designate user-specific information. Transceiver modules are generally small, with only a small portion of transceiver module visible when installed. The transceiver modules are also often installed in hard to access areas. It is difficult, therefore, to ensure that the mode designation color is visible to the user. Previously, color designation has been accomplished by, for example, manufacturing the entire assembly out of a single color material (typically a plastic), manufacturing the entire front of the module out of a single color material, or providing colored handles. However, manufacturing an entire assembly or significant portion thereof out of a single color material limits the usefulness of the assembly, as components of a particular color can only be used with a particular mode. In addition, to provide the necessary strength and visibility, plastic components are typically larger than would be preferred and add unwanted size to the device. Also, for some applications it is desirable to form components from materials which is not easily colored (such as metal for EMI shielding). Finally, although various standards have been given for the configuration of the transceiver module and the cage, variations between manufacturers exist as to some of the specific configurations. The variations between manufacturers are sometimes intended to satisfy different end-user requirements, such as how the transceiver is extracted from the cage. Consequently, some configurations of transceiver modules do not utilize components such as handles, making a color designating handle feature of no advantage. It is therefore desirable to have a color mode indicator that does not add to the size of the transceiver module, and that is easily adaptable and usable with different configurations of modules without requiring different tooling, molds, components, etc.

Summary of the Invention

A mode indicator for use with a transceiver module comprises a colored plastic button having an engagement feature configured for attachment to a corresponding transceiver module engagement feature.

Brief Description of the Drawings

Figure 1 is a perspective illustration of a transceiver module in accordance with the present invention plugged into a cage mounted on a printed circuit board.

Figure 2 is an exploded perspective illustration of the transceiver module.

Figure 3 is a perspective illustration of the housing of the transceiver module.

Figure 4 is a perspective illustration of the cage for receiving the transceiver module.

Figure 5 is an enlarged perspective view of the actuator wedge used in one configuration of the transceiver module.

Figure 6 is a bottom plan illustration of the assembled transceiver module.

Figure 7 is a perspective illustration of a release handle being used to remove the transceiver module from the cage.

Figures 8A and 8B are perspective illustrations of a release tool used to remove the transceiver module from the cage.

Figures 9A and 9B are enlarged perspective views of the mode indicator button used with the transceiver module.

Description of the Preferred Embodiments

In the following Detailed Description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this regard, directional terminology, such as "top," "bottom," "front," "back," "leading," "trailing," etc., is used with reference to the orientation of the Figure(s) being described. Because components of

embodiments of the present invention can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

Figure 1 illustrates transceiver module 10, face plate 11, cage 12, and printed circuit board (PCB) 14 in accordance with the present invention. Cage 12 is shown mounted to PCB 14. Cage 12 can be secured to PCB 14 in various ways consistent with present invention. Face plate 11 is fixed the PCB 14 and typically includes a plurality of openings. Cage 12 is illustrated extending through one of the openings in face plate 11. Cage 12 may be further secured to faceplate 11 with outwardly-extending prongs or springs or the like. Only a single cage 12 is illustrated extending through faceplate 11 for ease of illustration, but one skilled in the art will recognize that a multiplicity of cages can be mounted to PCB 14 and extend through faceplate 11 to receive a multiplicity of transceivers in accordance with the present invention.

Cage 12 includes cage latch 16. In Figure 1, transceiver module 10 is shown inserted into cage 12 and secured by cage latch 16. Cage latch 16 is resiliently biased to move toward transceiver module 10 thereby securing transceiver module 10 within cage 12. Cage latch 16 can also be moved away from transceiver module 10 so that transceiver module 10 can be extracted from cage 12, as will be described in more detail below.

Transceiver module 10 includes input/output receptacles 20 in its front face 21. Input/output receptacles 20 may be used to provide both input and output for optical and electrical signals to and from transceiver module 10. In other embodiments, one or more input/output receptacle 20 may be used. Front face 21 of transceiver module 10 is referred to as being at the front of transceiver module 10. However, in this regard, such directional terminology is used with reference to the orientation of the Figures being described and is in no way meant to be limiting. One skilled in the art will recognize that components of

embodiments of the present invention can be positioned in a number of different orientations.

In operation, optical and electrical signals can be transmitted to and from a destination or source that is plugged into input/output receptacles 20 to transceiver module 10. When transceiver module 10 is plugged into cage 12, it is in electrical communication with PCB 14 via the connections therebetween. Thus, signals can be sent to and from the PCB via transceiver module 10. Transceiver module 10 is hot pluggable and may be removed from cage 12 and replaced.

Figure 2 illustrates an exploded isometric view of the top-front side of a first configuration of transceiver module 10. Transceiver module 10 includes housing 22 which receives transceiver opto-electronic components 24 and electro-magnetic interference (EMI) shield 26. In the first configuration of transceiver module 10, release handle 27 and actuator wedge 28 are attached to housing 22 in manners described in greater detail below. A mode indicator button 30 is attached to housing 22 to indicate the particular mode of transceiver module 10. Module cover 32 is configured to fit over housing 22 of transceiver module 10 and protects opto-electronic components 24. Module cover 32 also helps secure module 10 in cage 12 when it is inserted therein, and also helps secure release handle 27 and actuator wedge 28 to housing 22.

In one embodiment, housing 22 is formed of a die cast or molded conductor, such as metal or conductive plastic, while module cover 32 is formed from stamped and shaped sheet metal. Release handle 27 is formed of shaped wire, while wedge 28 and mode indicator button 30 are formed of a plastic material.

In a second configuration of transceiver module 10, the same housing 22, opto-electronic components 24, EMI shield 26, mode indicator button 30 and module cover 32 are utilized, but release handle 27 and actuator wedge 28 are omitted from transceiver module 10. In this manner, different end-user configuration requirements for the transceiver module 10 can be satisfied with common components. In particular, housing 22 can be used for at least two different transceiver module configurations.

As best seen in Figure 3, the bottom side of housing 22 provides a surface 33. A latch boss 34 extends away from surface 33 such that the top of latch boss 34 is raised relative to surface 33. Latch boss 34 extends away from surface 33 and is configured to engage cage latch 16 of cage 12 (best seen in Figure 4). Specifically, when transceiver module 10 is inserted into cage 12, latch boss 34 deflects latch 16 slightly away from transceiver module 10 such that latch boss 34 travels past the front edge 36 of latch 16 and toward latch slot 40 in latch 16. When transceiver module 10 is fully inserted into cage 12, latch boss 34 is aligned with latch slot 40 such that latch boss 34 extends through latch slot 40. Latch 16 is configured with a bias such that when latch boss 34 is fully aligned with latch slot 40, latch 16 transitions toward transceiver module 10. In this way, transceiver module 10 will be locked into cage 12.

In one embodiment, latch boss 34 and latch slot 40 are configured to be triangular in shape and complement each other such that latch boss 34 fits through latch slot 40. Although latch slot 40 is specified as triangular in shape in the above-referenced Small Form-Factor Pluggable Transceiver Multi-Source Agreement, latch boss 34 and latch slot 40 may have shapes other than the triangular shape illustrated in the Figures. The shapes of latch boss 34 and latch slot 40 may be the same (i.e., both triangular, rectangular, circular, etc.), or may be different, so long as latch slot 40 is capable of securely engaging latch boss 34.

In the first configuration of transceiver module 10, release handle 27 is mounted in trough 37 or similar openings on housing 22. Handle 27 is mounted in trough 37 such that it can be rotated relative to transceiver module 10. Release handle 27 includes cam portion 39. As described in greater detail below, when handle 27 is rotated, cam portion 39 engages actuator wedge 28 and causes wedge 28 to move away from front face 21 of transceiver module 10. In one embodiment (best seen in Figure 5), tab portions 43 of module cover 32 trap handle 27 within trough 37 when module cover 32 is installed on housing 22.

In the first configuration of transceiver module 10, actuator wedge 28 (seen in Figures 2, 5 and 6) is slidably retained in a slot (shown as T-slot 42) that is provided on surface 33. Slot 42 is configured to retain actuator wedge 28 such

that wedge 28 can move toward and away from the front side 21 of transceiver module 10, but so that it cannot move laterally. The engaging shapes of actuator wedge 28 and slot 42 may differ from the T-shape illustrated, so long as slot 42 retains actuator wedge 28 adjacent surface 33 and permits wedge 28 to move toward and away from the front side 21 of transceiver module 10, but constrains lateral movement of actuator wedge 28.

Actuator wedge 28 includes tines 44 spaced to accommodate latch boss 34 therebetween, such that when latch boss 34 is placed between tines 44, as illustrated in the Figures and described in greater detail below, linear movement of wedge 28 (in the direction of arrow 45 in Figure 6) will not be impeded by latch boss 34 as wedge 28 moves away from the front face 21 of transceiver module 10. Tines 44 of wedge 28 are configured with ramp portions 52. As wedge 28 moves away from the front face 21 of transceiver module 10, ramp portions 52 of tines 44 engage latch 16 of cage 12 and deflect latch 16 away from surface 33 of module 10. Ramp portions 52 are illustrated as having a generally linear slope, but can also be designed with non-linear slopes.

To extract transceiver module 10 from cage 12, cage latch 16 must be moved away from surface 33 of transceiver module 10 a sufficient distance so that that latch slot 40 is removed from engagement with latch boss 34 and latch boss 34 clears the front edge 36 of latch slot 40, as will be described more fully below.

In the configuration of transceiver module 10 having release handle 27 and actuator wedge 28, the release handle 27 can be used to release transceiver module 10 from cage 12 so that it can be extracted therefrom. In Figures 1 and 6, release handle 27 is shown in a closed or 0° position, such that it is generally parallel with the front face 21 of transceiver module 10. In one embodiment, cam portion 39 of release handle 27 does not engage wedge 28 when release handle 27 is in the closed postion. As release handle 27 is rotated from the initial closed position toward a second open position (best seen in Figure 7), cam portion 39 moves away from the front of transceiver module 10 with the rotation, thereby engaging actuator wedge 28 and causing actuator wedge 28 to

move in an approximately linear direction within slot 42 away from the front face 21 of transceiver module 10 with the rotation of release handle 27.

As wedge 28 moves away from front surface 21, ramp portions 52 of wedge 28 engage cage latch 16 and deflect latch 16 away from surface 33 of transceiver module 10 and consequently away from latch boss 34. In this way, the movement of wedge 28 against latch 16 pushes latch 16 off latch boss 34 and provides clearance for latch boss 34 to pass out of latch slot 40. Once adequate clearance is provided, transceiver module 10 can be removed from cage 12, such as by pulling on handle 27.

In the configuration of transceiver module 10 in which release handle 27 and wedge 28 are not present, release tool 60 (illustrated in Figures 8A and 8B) can be used to release transceiver module 10 from cage 12 so that it can be extracted therefrom. Release tool 60 includes a handle portion 61 having connector engagement elements 62 at one end thereof. Engagement elements 62 are configured to engage receptacles 20 of transceiver module 10. Actuator arm 64 extends past connector engagement elements 62 and is shaped to approximately resemble wedge 28 at its distal end 66. Accordingly, similar reference numbers are used herein to designate similar parts. As described above with respect to wedge 28, when actuator arm 64 is actuated, such as by inserting the tool, ramp portion(s) 52 engages latch 16 of cage 12 and deflect latch 16 away from surface 33 of module 10.

To remove transceiver module 10 using release tool 20, actuator arm 64 is inserted through gap or opening 70 in front face 21 of housing 22. Opening 70 is sized to receive actuator arm 64 and permit actuator arm 64 to pass unimpeded through slot 42. From this first position, as removal tool 60 is advanced toward transceiver module 10, connector engagement elements 62 engage receptacles 20, and ramp portions 52 of actuator arm 64 engage cage latch 16. Ramp portion(s) 52 deflect latch 16 away from surface 33 of transceiver module 10 and consequently away from latch boss 34 to provide clearance for latch boss 34 to pass out of latch slot 40. Once actuator arm 64 of removal tool 60 is fully inserted and adequate clearance is provided, transceiver

module 10 can be removed from cage 12, such as by pulling on handle portion 61 of removal tool 60.

Actuator arm 64 of removal tool 60 is illustrated as spatially fixed with respect to handle portion 61 and connector engagement elements 62, such that connector engagement elements 62 engage receptacles 20 of transceiver module 10 concurrent with the engagement of actuator arm 64 and latch 16. In other embodiments, actuator arm 64 may be movable with respect to handle portion 61 and connector engagement elements 62, such that connector engagement elements 62 engage receptacles 20 of transceiver module 10 prior to the engagement of actuator arm 64 and latch 16.

Typically, fiber optic components use color to designate mode (e.g., wavelength, contact type, product type, etc.). Transceiver module 10 is generally small and only a small portion of transceiver module 10 is visible when installed in cage 12. Mode indicator button 30 (Figures 2, 9A and 9B) provides a highly visible color signal adjacent the front face 21 of transceiver module 10, and is visible from the front and top of transceiver module 10. Mode indicator button 30 is a molded plastic button (in any desired color) that is integral to the fiber optic input/output receptacles 20 of transceiver module 10, thereby clearly providing mode information to a user and adding no size to transceiver module 10. In one embodiment, mode indicator button 30 includes a recessed portion 80 in its back surface that is shaped to receive protrusion 81 of housing 22. Mode indicator button 30 may be secured to protrusion 81 by means including press fit and adhesive. In another embodiment, the positions of recessed portion 80 and protrusion 81 may be switched such that mode indicator button 30 has a protrusion receivable in a recessed portion of housing 22.

Mode indicator button 30 can be used to designate transceiver module 10 optical mode information, or in specific applications can be used by the end-user to designate user specific information. Mode indicator button 30 provides several advantages over previous color marking features, such as color coded molded handles. For example, mode indicator button is easily assembled for different mode configurations, adds no size to the transceiver module, and allows the use of either a handle 27 or a removal tool 60 to release the transceiver

module 10 from cage 12. Previous color marking features, such as color coded molded handles, are obviously of no advantage in a transceiver module with no handle.

Although specific embodiments have been illustrated and described herein for purposes of description of the preferred embodiment, it will be appreciated by those of ordinary skill in the art that a wide variety of alternate and/or equivalent implementations calculated to achieve the same purposes may be substituted for the specific embodiments shown and described without departing from the scope of the present invention. Those with skill in the mechanical, electro-mechanical, and electrical arts will readily appreciate that the present invention may be implemented in a very wide variety of embodiments. This application is intended to cover any adaptations or variations of the preferred embodiments discussed herein. Therefore, it is manifestly intended that this invention be limited only by the claims and the equivalents thereof.